Pertussis

(Also known as Whooping Cough)

This chapter has undergone extensive revision since the last edition of this manual. Changes include:

- Epidemiology: Updated information is presented on trends in adolescents and adults and in transmission to infants.
- Pertussis Vaccine for Adolescents and Adults: Tetanus, diphtheria, and acellular pertussis (Tdap) vaccines have been licensed for use in these age groups.
- Diagnostic Testing:
  - A PCR test for evidence of *Bordetella pertussis* infection is now routinely performed at the Massachusetts Department of Public Health (MDPH), State Laboratory Institute (SLI).
  - The SLI pertussis serology is not interpretable in those who have received Tdap within the last three years.
- Antibiotics: Azithromycin and clarithromycin are now approved for treatment and prophylaxis. They have also become the drugs of choice in infants and young children.
- Control Measures: Pertussis is now common in all communities and in many age groups, and antibiotic prophylaxis is no longer an effective tool to prevent spread. Therefore, prophylaxis has become much more focused on those at high risk of developing complications as well as on those who could potentially transmit disease to high-risk patients. Broad-based prophylaxis is no longer routinely recommended.
- Close Contacts: Redefined and now limited to those with very close contact with the case or the case's respiratory secretions. It no longer includes the group of individuals whose only exposure is sharing indoor airspace for at least ten hours per week with the case.

Section 1: ABOUT THE DISEASE

A. Etiologic Agent

Pertussis is caused by *Bordetella pertussis*, a fastidious, gram-negative, pleomorphic bacillus.

B. Clinical Description

Presentation

Classically, pertussis begins with mild upper respiratory tract symptoms (catarrhal stage, lasting 1–2 weeks) and can progress to severe paroxysms of cough (paroxysmal stage, lasting 2–6 weeks), often with a characteristic respiratory whoop, followed by vomiting. Although children can be exhausted after paroxysms, they usually appear relatively well between episodes. The cough is often worse at night. Cyanosis and apnea may occur; fever is absent or minimal. Paroxysms, if present, gradually decrease in frequency and intensity, and other symptoms also wane gradually

(convalescent stage, lasting weeks to months). During the recovery period, superimposed viral respiratory infections can trigger a recurrence of paroxysms.

The clinical presentation of pertussis varies with age, and diagnosis can be challenging. Disease in infants younger than six months of age may be atypical; apnea can be a manifestation, and whoop often is absent. Older children and adults can present with the classic symptoms of pertussis or with an atypical presentation. Among immunized individuals, particularly adolescents and adults, prolonged cough may be the only manifestation of pertussis. A number of studies have documented that between 13–32% of individuals in older age groups with a cough illness of 6 days or longer had serologic evidence of recent pertussis infection. One third of these individuals presented with a scratchy or irritated throat. Up to half of adults reported sweats. However, pertussis can also be quite severe in adolescents and adults. Of the cases identified in Massachusetts, over 85% report paroxysms; almost 50% report post-tussive vomiting; 30% report whoop; 30–40% report apnea; and 10% report cyanosis. Approximately 40% of adolescents and 60% of adults coughed for at least 100 days.

Complications

All infants <6 months of age and any infants with <3 doses of vaccine are especially vulnerable. Pertussis is most severe when it occurs during the first six months of life, particularly in preterm and underimmunized infants. Complications include primary or secondary bacterial pneumonia, seizures, hypoxic encephalopathy, and death. Most pertussis deaths occur in infants, particularly those <4 months of age. Conditions that may result from the effects of pressure generated by severe coughing include pneumothorax, epistaxis, subconjunctival hemorrhage, subdural hematoma, hernia, rectal prolapse, urinary incontinence, and rib fracture.

In adolescents and adults, problems sleeping (80%), weight loss (33%), pneumonia (2–4%), seizures (<1%), rib fracture (1–4%), and encephalopathy (<1%) are reported. Some complications, such as cough-induced urinary incontinence, increase with age, as do the more rare complications of chest pain and herniated intervertebral disc.

Differential Diagnosis

Physicians should include pertussis in their differential diagnosis for patients in all age groups who present with a prolonged cough illness. The diagnosis of pertussis is further complicated by the need to use diagnostic tests based on the age of the patient and the duration of symptoms, as described later in this chapter. Please refer to Section 2B for guidance on diagnostic tests. The differential diagnosis for pertussis often includes infections due to mycoplasma, chlamydia, respiratory syncytial virus (RSV), adenovirus, and other *Bordetella* species (e.g., *B. parapertussis* and *B. holmseii*).

Despite increasing awareness and recognition of pertussis as a disease that affects adolescents and adults, pertussis is overlooked in the differential diagnosis of cough illness in this population. Also, adolescents and adults often do not seek medical care until several weeks after the onset of their illness. Therefore, in addition to the agents listed above, the differential diagnosis in older age groups may include other causes of chronic cough, such as bronchospasm, gastroesophogeal reflux disease, post viral bronchospasm, sinusitis, and chronic lung disease.

Immunity

Recent evidence suggests that immunity to *B. pertussis* is not permanent. Immunity to pertussis has been shown to wane 5–10 years after vaccination with whole-cell vaccine (the duration of immunity may be longer with acellular vaccine). Immunity following natural disease also wanes over a period of time, and exposure to the organism with asymptomatic or mildly symptomatic infection may be needed to maintain effective protection.

C. Vectors and Reservoirs

Humans are the only host.

D. Modes of Transmission

Pertussis is transmitted from person to person by direct or droplet contact with nasopharyngeal secretions of an infected person.

E. Incubation Period

The incubation period is usually 7–10 days, with a range of 6–21 days.

F. Period of Communicability or Infectious Period

If not on antibiotics: From two weeks before to three weeks after cough onset.
If on antibiotics: From two weeks before cough onset through the fifth day of appropriate antibiotic treatment.

To determine a pertussis case's infectious period, it is helpful to have a calendar. The critical piece of information that is needed is the day the case began coughing, which is considered day zero. This information is usually obtained during follow-up with the health care provider regarding the patient's course of illness, as well as from the patient.

In the example below, the cough began on January 15th.

January

Su	Mo	Tu	We	Th	Fr	Sa
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	**15**	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	31			

February

Su	Mo	Tu	We	Th	Fr	Sa
				1	2	3
4	**5**	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28			

To determine the infectious period:

- Count back 2 weeks (14 days) from the cough onset. This would be January 1st.
- From the cough onset, count forward 3 weeks (21 days). This would be February 5th.

Therefore, the infectious period is from January 1st through February 5th. However, if the individual received appropriate antibiotics within that time period, the infectious period would end after the first five days of full adherence to a course of recommended antibiotic.

G. Epidemiology

Pertussis occurs worldwide. It is endemic, with peaks of incidence occurring every 2–5 years. Pertussis exhibits no distinct seasonality in the U.S. as a whole, although in Massachusetts, the months of greatest incidence are October–December. Pertussis is highly infectious, with secondary attack rates of 80% among non-immune household contacts. A silent carrier state has been identified, but it is infrequent and transient. It has been demonstrated to result in transmission in families, but its importance in maintaining *B. pertussis* in the community is unknown.

Following introduction of pertussis vaccine in the 1940s, pertussis incidence gradually fell in the U.S. However, over the last two decades, the incidence of disease has been increasing in all age groups, most strikingly in adolescents and adults. Protection after DTP/diphtheria, tetanus, and acellular pertussis vaccine (DTaP) wanes and is absent 5–10 years after the last dose. Many experts believe that waning immunity is a major contributing factor in the changing epidemiology of pertussis. This is particularly concerning, as older age groups may serve as a source of infection for infants and under-immunized preschool children.

In Massachusetts, adolescents and adults made up 90% of pertussis cases in recent years. Outbreaks in middle and high schools are common. Between 2000–2004, Massachusetts had 180 reported cases of pertussis in infants <1 year of age; most were either too young to be vaccinated or were under-immunized for age. This coincides with national trends, as during 1980–1998, the average annual incidence of reported pertussis cases and deaths among U.S. infants increased 50%. This increased morbidity and mortality occurred primarily among infants <4 months of age, who were too young to have received the recommended 3 doses of DTaP at ages 2, 4, and 6 months. Therefore, it is particularly important to ensure that infants receive their immunizations on time, according to the recommended schedule, and that every effort is made to catch up those who are behind in the schedule.

In 2005, two formulations of tetanus, diphtheria, and acellular pertussis (Tdap) vaccines were licensed for use in adolescents and adults. At the time of this writing, the Advisory Committee on Immunization Practices (ACIP) has issued preliminary recommendations for use in adolescents.

- A single dose of Tdap (instead of Td) is now recommended as a routine booster dose for adolescents at 11–12 years of age.
- Adolescents aged 11–18 years who have not yet received a Td booster dose should receive a single dose of Tdap instead of Td.

A single dose of Tdap is recommended for adults as well. However, the official recommendations for vaccination of adults with Tdap are still being developed. It is anticipated that Tdap will have a significant impact on pertussis in adolescents and adults.

Section 2:
REPORTING CRITERIA AND LABORATORY TESTING

A. What to Report to the Massachusetts Department of Public Health (MDPH)

Report a case of pertussis confirmed by any of the following means:

Laboratory-confirmed	◆ Isolation (culture) of *B. pertussis* from a clinical specimen (in someone with cough illness); ◆ A positive polymerase chain reaction (PCR) for *B. pertussis* nucleic acid; or ◆ A positive pertussis serology performed at the SLI.

Epidemiologically-linked	◆ Cough illness in a contact of a laboratory-confirmed case of pertussis, lasting ≥2 weeks, with ≥1 of the following symptoms: paroxysms of coughing, whoop, or post-tussive vomiting; or ◆ Cough illness lasting ≥2 weeks (with or without additional symptoms) occurring in a contact of a laboratory-confirmed case of pertussis in an outbreak setting (an institutional setting, such as a school, with ≥5 clustered cases, or a household setting with ≥1 case).

Currently, pertussis serology results are not valid for case confirmation, unless the test is performed at the SLI. The MDPH does not consider a patient with a positive serology result from another laboratory to be laboratory-confirmed. Please see Section 2B for information about what kind of confirmatory testing (if any) is appropriate for a patient with a positive pertussis serology at another laboratory.

Please note that the epidemiologically-linked classification is used for surveillance purposes only, and that epidemiologically-linked cases should receive treatment, if indicated. However, antibiotic treatment and control measures are generally necessary only for laboratory-confirmed cases, not for epidemiologically-linked cases without laboratory confirmation.

B. Laboratory Testing Services Available

There are three types of acceptable diagnostic tests for pertussis:

- Culture: Available at the SLI and at some diagnostic laboratories.
- PCR: Available at the SLI and at commercial laboratories.
- Serology: Only those assays performed at the SLI are acceptable for laboratory confirmation.

Note: Results from other laboratories are not considered interpretable by the MDPH or the Centers for Disease Control and Prevention (CDC).

Culture

A positive culture for *B. pertussis* in a person with cough illness confirms the diagnosis of pertussis. However, although bacterial culture is specific for the diagnosis, it is relatively insensitive. Fastidious growth requirements make *B. pertussis* difficult to isolate. Isolation of the organism from a nasopharyngeal (NP) swab is most successful during the catarrhal stage (i.e., first 1–2 weeks of cough). Antibiotics decrease the likelihood of recovering the organism; however, patients treated with antibiotics should still be cultured.

PCR

PCR testing of NP swabs can be a rapid, sensitive, and specific method for diagnosing pertussis. However, the high sensitivity of the test means false positive results may be obtained. Therefore, PCR results should be considered presumptive, and isolation of *B. pertussis* by culture should be attempted for confirmation. PCR is most reliable within the first three weeks after onset of cough and before the initiation of antibiotic therapy. However, treatment should not be postponed for testing. Beyond this period, false negative results become more likely, though PCR can detect the organism's nucleic acid after antibiotic administration and for up to four or more weeks after onset of cough.

PCR testing became available at the SLI in January 2005. PCR and culture testing is routinely performed on all NP swabs submitted to the SLI for pertussis testing.

Serology

Serology (performed at the SLI), a single-serum assay for IgG to pertussis toxin, is most sensitive 2–8 weeks after onset of cough. Serologic testing is not valid in children <11 years of age; blood or serum obtained from children <11 years of age will not be accepted for serologic assay. Failure to provide patient date of birth may result in delay in specimen testing.

Serologic results on patients ≥11 years of age that have received a pertussis-containing vaccine (Tdap) within the past 3 years are not interpretable. Antibodies in these individuals may be the result of vaccination and/or recent infection. As more data become available about the persistence of antibody after receipt of Tdap, this interval for interpretation may be adjusted. Consider submission of a NP swab for pertussis PCR and culture, if within the appropriate time interval relative to cough onset. Currently, pertussis serology results from laboratories other than the SLI are not accepted as diagnostic for pertussis by the MDPH or the CDC.

Diagnostic Test Selection

Culture, PCR, and serologic testing are available at no charge at the SLI. The appropriate pertussis diagnostic test and specimen type is based on patient age and cough duration, as described in the table below. The reliability of each test depends on age and stage of disease. Ongoing experience with PCR testing may guide further refinement of recommendations.

Diagnostic Test Recommendations for Testing for Pertussis

Time Since Cough Onset	Patients <11 Years of Age	Patients ≥11 Years of Age
<14 days	NP swab for culture and PCR	NP swab for culture and PCR
14–28 days	NP swab for culture and PCR	Serology at SLI[1] -OR- Serology at SLI, and consider NP swab for culture and PCR
29–56 days	NP swab for culture and PCR	Serology at SLI

1 Serologic results for patients ≥11 years of age who have received a pertussis-containing vaccine (TdaP) within the past 3 years are not interpretable. Detected antibodies in these individuals may be the result of either past vaccination and/or recent infection. Instead, consider submission of a NP swab for pertussis and culture testing if within the appropriate time interval relative to cough onset.

Diagnostic Specimen Submission

NP kits for pertussis culture and PCR can be ordered from the SLI at (617) 983-6640. Because NP test kits have a short shelf life (two months), only the quantity to be used immediately should be ordered. All specimens must be accompanied by a fully completed SLI *Specimen Submission Form* (found at the end of this chapter and on the MDPH website at www.mass.gov/dph/bls/generalform.pdf). Instructions for specimen collection are included in the kits. For serologic testing, 1–2 mL of serum or 5–10 mL of whole blood collected in a red top or serum separator tube should be submitted (serum is preferable to whole blood). PCR results are usually available within a few business days of specimen receipt; culture results, usually within a week; and serology in approximately 1–2 weeks.

Section 3:

REPORTING RESPONSIBILITIES AND CASE INVESTIGATION

A. Purpose of Surveillance and Reporting

- To identify sources of infection, sites of transmission, and additional cases.
- To identify exposed persons to assure timely administration of antimicrobial prophylaxis, and to prevent further spread of infection.
- To monitor the effectiveness of outbreak control strategies.
- To monitor the effectiveness of the new adolescent and adult Tdap vaccines.

B. Laboratory and Health Care Provider Reporting Requirements

Pertussis is reportable to the local board of health (LBOH). The MDPH requests that health care providers immediately report to the LBOH in the community where the case is diagnosed, all confirmed or suspect cases of pertussis, as defined by the reporting criteria in Section 2A.

Laboratories performing examinations on any specimens derived from Massachusetts residents that yield evidence of pertussis infection shall report such evidence of infection directly to the MDPH within 24 hours.

C. Local Board of Health (LBOH) Reporting and Follow-Up Responsibilities

Reporting Requirements

MDPH regulations *(105 CMR 300.000)* stipulate that pertussis is reportable to the LBOH and that each LBOH must report any case of pertussis or suspect case of pertussis, as defined by the reporting criteria in Section 2A. Cases should be reported to the MDPH Bureau of Communicable Disease Control, Office of Integrated Surveillance and Informatics Services (ISIS) using an official MDPH *Pertussis Case Report Form* (found at the end of this chapter). Refer to the *Local Board of Health Timeline* at the end of this manual's *Introduction* section for information on prioritization and timeliness requirements of reporting and case investigation.

Case Investigation

1. LBOH generally take the lead on follow-up of serologically-confirmed cases; MDPH epidemiologists generally take the lead on culture and PCR-confirmed cases. In either instance, a MDPH *Pertussis Case Report Form* (found, with *Instructions for Filling Out the Pertussis Case Report Form,* at the end of this chapter) and a *Pertussis Contact Worksheet* (found at the end of this chapter) are used to collect information. Detailed guidelines on case investigation and disease control are provided in Section 4. MDPH staff is available to conduct trainings in pertussis follow-up for LBOH officials.
2. After completing the form, attach laboratory report(s) and fax or mail (in an envelope marked "Confidential") to ISIS. The confidential fax number is (617) 983-6813. Call ISIS at (617) 983-6801 to confirm receipt of your fax. The mailing address is:

MDPH, Office of Integrated Surveillance and Informatics Services (ISIS)
305 South Street, 5th Floor
Jamaica Plain, MA 02130
Fax: (617) 983-6813

3. Institution of disease control measures is an integral part of case investigation. It is the responsibility of the LBOH to understand, and if necessary, institute the control guidelines listed in Section 4.

Section 4:

CONTROLLING FURTHER SPREAD

A. Isolation and Quarantine Requirements *(105 CMR 300.130)*

Minimum Period of Isolation of Patient

Until 21 days from onset of cough, or 5 days after initiation of appropriate antibiotic therapy. The first full day of antibiotics is considered to be Day 1.

Minimum Period of Quarantine of Contacts

If the contact is symptomatic, use same restrictions as for cases. If the contact is an asymptomatic health care worker not receiving antibiotic prophylaxis, exclude from the workplace for 21 days after last exposure, or if last exposure is unknown, for 21 days after the onset of the last case in the setting. If the contact is asymptomatic, not a health care worker, and exposed within the last 21 days, s/he should receive antibiotic prophylaxis, but no exclusion is generally required. In certain situations deemed to be high-risk, the MDPH may require exclusion of asymptomatic contacts not receiving antibiotic prophylaxis and/or other contacts, and/or may extend the exclusion period beyond 21 days up to a maximum of 42 days.

Neither treatment nor exclusion is required for cases beyond their infectious period, which lasts 21 days after cough onset. Asymyptomatic health care worker contacts who are receiving post-exposure prophylaxis do not need to be excluded.

Please refer to the most recent isolation and quarantine requirements on the MDPH website at www.mass.gov/dph/cdc/epii/reportable/reportable.htm.

B. Antibiotics

Many changes have been made to the recommendations for antibiotic treatment and prophylaxis for pertussis.

Macrolide Antibiotics

1. The newer macrolides (clarithromycin and azithromycin) are now approved for use in the treatment and prophylaxis of pertussis and are the drugs of choice.
   a. For infants <1 month of age, azithromycin is preferred over erythromycin, and clarithromycin is not recommended.

b. In persons ≥1 month of age, erythromycin, clarithromycin, and azithromycin are the preferred antibiotics.

   i. The dosing schedule in the Z-PAC® formulation of azithromycin is now acceptable for older children and adults.

c. Trimethoprim-sulfamethoxazole (TMP-SMZ) is no longer recommended, but may be used as an alternative agent in patients who are allergic to macrolides, who cannot tolerate macrolides, or who are infected with a rare macrolide-resistant strain of *B. pertussis*.

Treatment

1. Recommended treatment courses:
   a. 5-day course of azithromycin.
   b. 7-day course of clarithromycin.
   c. 14-day course of erythromycin.
2. Treat within 3 weeks (21 days) of cough onset. However, there are situations in which treatment is recommended or considered >21 days after cough onset:
   a. Treatment should be initiated within 42 days (6 weeks) of cough onset in infants <12 months of age and pregnant women in their 3rd trimester. Please consult with the MDPH about treatment recommendations for individuals meeting these criteria.
   b. Treatment should be initiated in any coughing individual who is culture positive, regardless of time since cough onset.
   c. For individuals who have had a serologically positive diagnosis >21 days from cough onset, treatment is not usually indicated. In individuals who are PCR positive >21 days from cough onset, treatment could be considered (depending on the circumstances). Please consult with MDPH about treatment recommendations for these individuals.
3. Please refer to the section on timing of antibiotic treatment in *Attachment A: General Recommendations for Antibiotic Treatment and Prophylaxis of Pertussis* for further details.

Antibiotic Prophylaxis

The antibiotic doses and schedules for prophylaxis are the same as for treatment. Initiate antibiotic prophylaxis within 21 days of exposure. However, prophylaxis should be considered within 42 days (6 weeks) after exposure for infants <12 months of age (particularly those <6 months of age, with <3 doses of DTaP) and pregnant women in their 3rd trimester. Please consult with MDPH about prophylaxis recommendations for individuals meeting these criteria.

Antibiotic prophylaxis has acquired a narrower focus for the following reasons:

- Pertussis is now common in all communities, in many age groups, and may not be diagnosed or reported.
- An individual may have multiple exposures, but may only be able to identify some of these exposures.
- Prophylaxis must be given early in order to be effective.
- When pertussis is widespread in institutions and/or communities, antibiotic prophylaxis does not control transmission.

- Due to multiple known exposures to cases of pertussis over a period of time (e.g., a few months), an individual could receive several courses of antibiotics, which could result in side effects and may promote the emergence of antibiotic resistance.

New recommendations for antibiotic prophylaxis:

- Due to the reasons listed above, recommendations have been revised and are now more targeted in nature.
- Only close contacts (new definition is described in Section 4D) should receive antibiotic prophylaxis, and efforts should be focused on contacts who are at high risk for severe pertussis disease or contacts who could transmit pertussis to those at high risk.
  - In general, during a school or community outbreak, antibiotics are now indicated for a limited number of individuals who are close contacts. Antibiotic prophylaxis is **no longer routinely recommended for entire classrooms** of school-aged children when there is only one laboratory-confirmed case of pertussis.
  - Infants and other high-risk individuals in whom pertussis is **suspected** should be **treated presumptively** after clinical specimens for diagnostic testing are obtained.
  - Infants and other high-risk individuals who are **exposed** to pertussis should receive antibiotic **prophylaxis promptly**.

Please refer to *Attachment A: General Recommendations for Antibiotic Treatment and Prophylaxis of Pertussis*, at the end of this chapter, and to the table in the attachment, *Summary of Oral Macrolide Treatment and Prophylaxis by Age Group*, for more information about antibiotics for pertussis treatment and prophylaxis.

C. Control Measures for the Case

The most important pieces of information that are needed to make appropriate recommendations are: 1) the date of cough onset; and 2) if/when appropriate antibiotics were taken. This information helps determine the case's infectious period (see the figure in Section 1F for assistance with calculations).

In general, outside of an outbreak setting, control measures are necessary only for laboratory-confirmed cases. Antibiotic prophylaxis and other control measures are generally not recommended for epidemiologically-linked cases without laboratory confirmation (exceptions may involve high-risk settings).

1. If the case has been coughing ≤21 days:
   a. Diagnostic confirmation: Ensure the case has a valid, positive diagnostic test (while culture and PCR are accepted from any laboratory, only serologic tests done at the SLI are interpretable).
   b. Treatment: Appropriate antibiotic treatment is required (refer to *Attachment A*: *General Recommendations for Antibiotic Treatment and Prophylaxis of Pertussis*, at the end of this chapter, for further details).
   c. Exclusion: Exclude from public activities, school, and the workplace through the first 5 days of the full course of antibiotics, or through 21 days from the onset of cough for those who do not receive antibiotics.
2. If the case has been coughing >21 days:
   a. Diagnostic confirmation: Ensure the case has a valid, positive diagnostic test (while culture and PCR are accepted from any laboratory, only serologic tests done at the SLI are interpretable).
   b. Treatment: Antibiotic treatment is **not** recommended, as it is already beyond the infectious period and initiating treatment more than 21 days after onset of cough is unlikely to be beneficial. However, there are situations in which treatment is recommended >21 days after cough onset:

i. Treatment should be initiated within 42 days (6 weeks) of cough onset in infants <12 months of age and pregnant women in their 3rd trimester. Please consult with MDPH about treatment recommendations for individuals meeting these criteria.

ii. Treatment should be initiated in any coughing individual who is culture positive, regardless of time since cough onset.

iii. Please refer to the section on timing of antibiotic treatment in *Attachment A: General Recommendations for Antibiotic Treatment and Prophylaxis of Pertussis,* at the end of this chapter, for further details.

3. Exclusion: No exclusion is necessary.

Note: In certain situations deemed to be high-risk, MDPH may make additional recommendations regarding control measures (e.g., treatment, prophylaxis, and exclusion.)

D. General Control Measures for Close Contacts

Several changes have been made to recommendations for prevention and control. These include:

- A reduction in the number of people who are considered close contacts, and thereby, require antibiotic prophylaxis.
- Focus of efforts on preventing spread of pertussis from the case to high-risk individuals, especially infants and particularly infants who are <6 months of age (since serious complications and death occur most frequently in this youngest group).
- Focus of efforts on contacts who are likely to transmit the disease to high-risk individuals.

Recommended antibiotics for treatment and prophylaxis have changed. Please refer to *Attachment A: General Recommendations for Antibiotic Treatment and Prophylaxis of Pertussis,* at the end of the chapter, for further details.

Identification of Close Contacts

Pertussis is now a common disease in adolescents and adults, and it is often not diagnosed or reported. Antibiotic prophylaxis does not control the transmission of pertussis when it is widespread in an institution or community. Therefore, the definition of what constitutes exposure (i.e., close contact) with a case of pertussis and the application of this definition to control measures have been revised:

- The definition of those considered exposed (i.e., close contacts) has become **narrower** in order to decrease the number of times individuals may need to take multiple courses of antibiotics, which are associated with serious side effects and may promote the development of antibiotic resistance.
- Efforts should be focused on contacts that are at high risk for severe pertussis (e.g., infants, particularly those <6 months of age, or immunocompromised individuals) or contacts who could transmit pertussis to those at high risk. (See page 604 for help with identification of "high-risk" and "transmission-risk" contacts.)

Identify individuals or groups with close contact with the case. In health care settings, control guidelines are more stringent—please refer to the section of this chapter on *Health Care Settings* in Section 4E for more information. See table on next page for the definition of a "close contact."

Definition of a Close Contact of a Case of Pertussis

Direct Contact	Have had direct contact with respiratory, oral, or nasal secretions from an infectious case. Examples include: ◆ An explosive cough or sneeze in the face; ◆ Sharing food/eating utensils during a meal; ◆ Kissing; ◆ Sharing lip gloss, lipstick, cigarettes, or similar items; or ◆ Performing medical/dental examination or procedure (e.g., suction, intubation, or bronchoscopy).
Face-to-Face Contact	Have had close face-to-face contact, regardless of duration, with a case that is symptomatic and infectious (e.g., in the catarrhal or paroxysmal period of illness). This does not include casual contact, like sharing the same classroom, waiting room, office space, or other casual types of interactions, except in some rare circumstances (as described in note on casual types of exposure below).
Household Contact	Includes persons who occupy a particular housing unit as their usual residence, or who live there at the time of disease in the case, and other close contacts, including caregivers who come to the house regularly, friends/relatives who visit often, and intimate contacts of the case.

Note on more casual types of exposure: Those who share confined space in close proximity for a prolonged period of time (e.g., in a regular classroom, five days/week) with a case that is symptomatic and infectious are no longer considered close contacts. Sharing indoor airspace for at least ten hours per week is no longer used to determine close contacts. The instances in which such a setting would constitute significant exposure—and therefore, antibiotic prophylaxis would be recommended—are rare and generally limited to regular classrooms with more than one laboratory-confirmed case or classrooms in which close exposure might be more frequent, such as with special needs students or where more vulnerable individuals might be present.

In general, during a school or community outbreak, antibiotics are **only** indicated for a limited number of individuals who fit the definition of a close contact. Entire classrooms of school-aged children are no longer routinely prophylaxed when there is only one laboratory-confirmed case (and in the absence of high-risk situations/individuals).

Some examples of close contacts, as currently defined, include:

- Contact in group settings where close interactions occur (e.g., after-school care groups, playgroups, core group of close friends, lunch partners, carpool, or teammates);
- Participation in extracurricular activities or field trips;
- Boyfriend/girlfriend;
- Those involved in sharing food, drink, or eating utensils;
- Classmates and caregivers in a childcare setting; or
- Individuals in a special needs program classroom.

Identification of "High-Risk" Contacts

Identify all individuals who are at high risk for severe disease and adverse outcomes. These include:

- Infants <1 year of age (particularly those <6 months of age);
- Immunocompromised individuals;
- Individuals with chronic lung disease (including asthma and cystic fibrosis);
- Individuals with neuromuscular disorders that prevent or reduce the ability to clear secretions; or
- Unimmunized or underimmunized children.

Refer these contacts, whether they have symptoms or not, for medical evaluation and antibiotic prophylaxis, if within the proper timeframe, to prevent disease.

Identification of "Transmission-Risk" Contacts

Identify transmission-risk contacts. Transmission-risk contacts are defined as those who may transmit the disease to persons at high risk for severe disease and adverse outcomes (as defined above) and may include:

- Household members and other close contacts in a household setting where there is a high-risk individual.
- Pregnant women in their 3rd trimester (due to concern about transmission to their newborn).
- Those attending or working in childcare settings (i.e., same room), if there are infants or a pregnant woman who is in her 3rd trimester or other high-risk individuals in the setting.
- Health care workers providing direct patient care, particularly to those listed as high-risk (e.g., NICU, obstetrics, labor and delivery, or bone marrow transplant unit).

It is important that these contacts are carefully evaluated for symptoms and placed on antibiotics, if within the proper timeframe, to prevent disease and further transmission.

Identification of Symptomatic Close Contacts

Identify all close contacts with symptoms suggestive of pertussis. Questions to ask include:

- Do you have cold symptoms (runny nose, sneezing); when did they start?
- Do you have a cough; when did it start?
- Describe your cough.

Note: Ask open-ended question first; proceed to the following only if the interviewee does not give details.

- Do you feel as if you are choking and cannot breathe?
- Do you cough at night or is coughing worse at night?
- Do you have coughing spells where you feel as if you cannot stop coughing?
- Do you vomit or almost vomit after coughing?
- Are there other people in your house (or class, team, extracurricular group, worksite, close friends, etc.) with a cough?
- How long have they been coughing?

- What is their cough like?
- Where do they work/attend school/etc.?

Management of Close Contacts

The appropriate management of contacts depends on: 1) whether or not the contact has symptoms; 2) how long the contact has been coughing; and 3) the time since this contact was exposed to the case (while the case was infectious). (See the *Review of Immunization Status of Contacts* section for more information.)

Symptomatic Close Contacts

Symptomatic close contacts should be treated as suspect cases of pertussis.

1. If contacts have been coughing ≤21 days:
   a. Diagnostic evaluation: Refer for medical evaluation and diagnostic testing, as appropriate for age and cough duration (see above for more information).
   b. Treatment/prophylaxis: Begin on presumptive antibiotic treatment (refer to *Attachment A: General Recommendations for Antibiotic Treatment and Prophylaxis of Pertussis,* at the end of this chapter, for further details).
   c. Exclusion: Exclusion is the same as for a case—exclude from public activities, school, and the workplace through the first 5 days of the full course of antibiotics, or 21 days from the onset of cough for those who do not receive antibiotic treatment.
2. If contacts have been coughing >21 days:
   a. Diagnostic evaluation: Refer for medical evaluation and diagnostic testing, as appropriate for age and cough duration (see above for more information).
   b. Treatment/prophylaxis: Antibiotic treatment is **not** recommended, as contacts are already beyond their infectious period, which ends 21 days after cough onset. Initiating treatment >21 days after onset of cough is unlikely to be beneficial. However, there are situations in which treatment is recommended >21 days after cough onset:
      i. Treatment should be initiated within 42 days (6 weeks) of cough onset in infants <12 months of age and pregnant women in their 3rd trimester. Please consult with MDPH about treatment recommendations for individuals meeting these criteria.
      ii. Treatment should be initiated in any coughing individual who is culture positive, regardless of time since cough onset.

      Note: Please refer to the section on timing of antibiotic treatment in Attachment A: General Recommendations for Antibiotic Treatment and Prophylaxis of Pertussis, at the end of this chapter, for further details.
   c. Exclusion: No exclusion is required, even for infants <12 months of age and pregnant women in their 3rd trimester—even if they haven't taken antibiotics in the 22–42 days after cough onset.

Asymptomatic Close Contacts

Asymptomatic contacts should be educated about the signs and symptoms of pertussis and should be advised to seek medical evaluation and testing, should symptoms develop.

1. If last exposure occurred ≤21 days ago:
   a. Diagnostic evaluation: No medical evaluation is needed, unless contact develops symptoms.
   b. Prophylaxis: Recommend antibiotic prophylaxis. However, for asymptomatic cases whose only relevant exposure was to an epidemiologically-linked case (not laboratory-confirmed), prophylaxis is generally not recommended. Refer to *Attachment A: General Recommendations for Antibiotic Treatment and Prophylaxis of Pertussis,* at the end of this chapter, for further details.
   c. Exclusion: No exclusion is required, even if antibiotics are not taken, except for some transmission-risk contacts, which include:
      i. Health care workers—see above for further details.
      ii. Individuals in a childcare setting where there is contact with infants <1 year of age—see above for further details.

2. If last exposure occurred >21 days ago:
   a. Diagnostic evaluation: No medical evaluation is needed, unless contact develops symptoms.
   b. Prophylaxis: Antibiotic prophylaxis is **not** recommended, as initiating prophylaxis >21 days after exposure is unlikely to be beneficial. However, prophylaxis should be considered for infants <12 months of age (particularly those <6 months of age, with <3 doses of DTaP) and pregnant women in their 3rd trimester. Please consult with MDPH about prophylaxis recommendations for individuals meeting these criteria.
   c. Exclusion: No exclusion is required, even for infants <12 months of age and pregnant women in their 3rd trimester, if they haven't taken antibiotics in the 22–42 days after exposure.

Review Immunization Status

In addition to the recommendations listed above, please take the opportunity to assess the immunization records of contacts to see if doses of DTaP or Tdap are indicated.

1. Contacts who are <7 years of age: Contacts who are unimmunized or have received <5 doses of DTaP should, in addition to receiving antibiotic prophylaxis (if recommended), have pertussis immunization initiated or continued as soon as possible after exposure, according to the following guidelines:
   a. Give 1st dose at ≥6 weeks of age; doses 1, 2, and 3 must be separated by at least 4 weeks.
   b. Children who have received their 3rd dose of DTaP ≥6 months before exposure should receive a 4th dose at this time.
   c. Children who have received four doses of DTaP should get a booster of DTaP, unless a dose has been given within the last three years.
2. Contacts 7–9 years of age: Currently there is no licensed pertussis-containing vaccine approved for use in this age group.
3. Contacts 10–64 years of age: There are two Tdap formulations licensed for use within this age group. Adacel™ is approved for use in individuals ages 11–64 years and Boostrix® is for ages 10–18 years. Please consult the package inserts of the formulations for more detailed information.

   At the time of this publication, the official recommendations of the ACIP on the use of Tdap have not been published. However, interim recommendations for adolescents and adults state the following:

Adolescents

a. Providers may wish to administer a single dose of Tdap to adolescents who are at increased risk of exposure to pertussis or to those with high-risk contacts (e.g., infants <6 months of age, children who are not vaccinated, pregnant women who are in their 3rd trimester). Post-exposure antibiotics prophylaxis and other pertussis control guidelines are still indicated.

b. In adolescents, a 5-year interval between Td and Tdap is encouraged to reduce the potential risk for local or systemic reactions. However, the ACIP did not define an absolute minimum interval between Td and Tdap, in order to give maximum flexibility to providers. Intervals shorter than five years between Td and Tdap can be used. The safety of intervals as short as two years between Td and Tdap is supported by a Canadian study among nearly 6,000 children/adolescents. The benefits of protection from pertussis generally outweigh the risk of local or systemic reactions in settings with increased risk from pertussis.

Adults

a. For adults 19–64 years of age who have not yet received Tdap, a single dose of Tdap should be administered to replace a single dose of Td for booster immunization against tetanus, diphtheria, and pertussis, if the individual received his/her most recent tetanus-containing vaccine (e.g., Td ≥10 years ago).

    i. In order to provide protection against pertussis, an interval as short as two years between Td and Tdap is thought to be safe.

b. Adults who have or anticipate having close contact with an infant <12 months of age (e.g., parents, childcare providers, health care providers) should receive a single dose of Tdap. Ideally, Tdap should be given at least one month before beginning close contact with the infant. Women should receive a dose of Tdap in the immediate post-partum period if they have not previously received Tdap. Any woman who might become pregnant is encouraged to receive a single dose of Tdap.

Please consult with the MDPH and check the CDC website at www.cdc.gov/nip/recs/provisional_recs for the final recommendations for use of Tdap.

Many experts currently recommend that children (especially infants <1 year of age) with a history of pertussis disease complete the routine childhood vaccination series for pertussis with DTaP. The preliminary ACIP guidance states that adolescents and adults with a history of pertussis generally should receive a single dose of Tdap. Please consult with the MDPH for the most current guidelines.

Notification

Ensure that the LBOH, MDPH, and other public health officials in affected communities are aware of the case and of all the pertinent details of control measures. Additionally, close contacts may be notified of their exposure and the recommendations by telephone or in writing. If there are multiple cases over a short period of time, a general notification letter may be used to a wider group within the facility or institution. The MDPH can provide model letters and these may be issued on the stationary of the institution or the LBOH. A Pertussis Fact Sheet and letters for health care providers are also available. Call the MDPH Division of Epidemiology and Immunization at (617) 983-6800 or (888) 658-2850 to get copies of these letters.

Conduct Active Surveillance

In institutional settings, conduct active surveillance for cough illness, with referral of suspect cases for medical evaluation, diagnostic testing, and antibiotic prophylaxis. In health care settings, surveillance should be initiated

immediately after identification of a suspect case. Surveillance should continue through 2 incubation periods (42 days) after the date of cough onset in the last case. Please refer to the *Schools* section in Section 4E for specific recommendations for implementing active surveillance in institutions.

E. Management of Special Situations: Schools, Childcare Centers, and Health Care Settings

SCHOOLS

Please follow the steps for management of a case and contacts presented earlier in this chapter, in conjunction with the school-specific guidance below. An immunization epidemiologist at MDPH (available at [617] 983-6800, or [888] 658-2850) or your MDPH Regional Immunization Office can provide help with case investigation and outbreak control in the school setting.

Significant changes have been made in recommendations for the control of pertussis in the school setting:

- The definition of a close contact is narrower and no longer includes the entire classroom.
- The criterion of sharing indoor airspace for at least ten hours per week is no longer used to determine close contact.
- Routine prophylaxis of entire classrooms of school-aged children is no longer recommended. (However, there may be some rare exceptions to this, such as special needs classrooms. Please consult with MDPH for additional guidance about unusual circumstances.)

Special Guidance for Schools

Identification of Close Contacts

Work with the school nurse or other school personnel (such as student teachers and sports team coaches) to identify close contacts. See Section 4D for further guidance.

Identification of High-Risk and Transmission-Risk Contacts

Pay particular attention to identifying any exposed individuals who are at higher risk of developing complications from pertussis as well as to those who could transmit the disease to high-risk contacts.

Identification of Symptomatic Close Contacts

1. Notify teachers or coaches who have a case in their classes or on their sports teams to refer other coughing children to the nurse's office for evaluation.
2. Determine whether there are any teachers who are close contacts (including student teachers) or staff who have been coughing.
3. Refer symptomatic close contact students, teachers, or other staff for medical evaluation and diagnostic testing. (*Note: Testing every suspect case is not necessary when there is a recognized and well-documented outbreak in progress.*) An immunization epidemiologist at MDPH (available at [617] 983-6800 or [888] 658-2850) or your MDPH Regional Immunization Office can provide further guidance on this issue.
4. Keep track of symptomatic close contacts in a line listing of suspect cases. MDPH provides a *Pertussis Surveillance Log Sheet* and a *Pertussis Surveillance Summary Sheet* for these purposes (both forms are found at the end of this chapter). This information will help in deciding whether whole groups need to be prophylaxed.

Management of Close Contacts

1. The appropriate management of contacts depends upon: 1) whether the contact has symptoms; 2) how long the contact has been coughing; and 3) the time since this contact was exposed to the case (while the case was infectious). Please see Section 4D for guidance, with the following exceptions for treatment/prophylaxis:
    a. Asymptomatic contacts should be educated about the signs and symptoms of pertussis and should be advised to seek medical evaluation and testing, should symptoms develop.
    b. Treatment/prophylaxis: In general, prophylaxis is **not** indicated in a classroom or similar setting (where a group of individuals spend at least five days/week together) where there is one laboratory-confirmed case. In the school setting, prophylaxis should be limited to those defined as close contacts, as defined in Section 4D. Situations where prophylaxis may be indicated are:
        i. Individuals within the group may receive prophylaxis if they fit the definition of a close contact (e.g., boyfriend or girlfriend of the case, on the same sports team, share food or drink), or are considered a high-risk contact (e.g., pregnant woman in her 3rd trimester), or are considered a transmission-risk contact (e.g., a member of a household where there is a high-risk individual).
        ii. In some instances, such as a classroom for special needs students or where there are significant numbers of high-risk contacts, it may be appropriate to prophylax the whole group, unless >21 days have passed since cough onset in the last symptomatic person or the case was not present during his/her infectious period.
        iii. The extent to which prophylaxis is recommended will vary according to the extent of exposure, the presence/absence of other coughing students, whether any other cases of pertussis have been reported in the area, and whether high-risk individuals are present. Consult an immunization epidemiologist at MDPH if you are in doubt.
        iv. For contacts in classrooms and other groups in which there is >1 laboratory-confirmed case, it may be appropriate to prophylax the entire group, unless >21 days have passed since cough onset in the last symptomatic person or the cases were not present during their infectious periods. The extent to which this recommendation is applied will vary according to the extent of exposure, the presence/absence of other coughing students, whether there is any other reported pertussis in the area, and whether high-risk individuals are present. Consult an immunization epidemiologist at MDPH if you are in doubt.
        v. For childcare settings, see below for more specific guidance.

Review Immunization Status

See Section 4D for guidance.

Notification

Send letters of notification to close contacts. If there are multiple cases over a short period of time, a general notification letter may be used to a wider group within the facility or institution. The MDPH can provide model letters, and these may be issued on the stationary of the affected institution or the LBOH. A Pertussis Fact Sheet and letters for health care providers are also available. Call the MDPH Division of Epidemiology and Immunization at (617) 983-6800 or (888) 658-2850 to get copies of these letters. Educational materials should include information about the signs and symptoms of pertussis, and close contacts should be advised to seek medical evaluation and testing, should symptoms develop.

If feasible, it is helpful to telephone the contacts, especially the symptomatic ones, as well as sending the letters home. The school nurse usually makes these calls.

Conduct Active Surveillance

Continue initial surveillance efforts for 2 incubation periods (42 days) after the date of cough onset in the late case, as outlined in Section 4D.

Childcare Centers

The main focus in childcare is preventing the transmission of pertussis to infants, particularly those <6 months of age (as well as other high-risk individuals). Therefore, keep the following in mind:

- Carefully evaluate the situation with regard to staff that may work in several different classrooms throughout the day or week and have contact with the case as well as with infants. Entire classrooms in the childcare setting (including the classroom staff) are considered close contacts and should receive antibiotic prophylaxis, if indicated.
- Keep in mind that treatment should be initiated within 42 days (6 weeks) of cough onset in infants <12 months of age and in pregnant women in their 3rd trimester.
- Prophylaxis should be considered for contacts of a case that are infants <12 months of age (particularly those <6 months of age, with <3 doses of DTaP) or pregnant women in their 3rd trimester.
- Please consult with the MDPH about treatment/prophylaxis recommendations for individuals meeting these criteria.

Please follow the steps for management of a case and contacts outlined in Section 4D, in conjunction with the childcare-specific guidance below. An immunization epidemiologist at MDPH (available at [617] 983-6800 or [888] 658-2850) or your MDPH Regional Immunization Office can provide help with case investigation and outbreak control in the childcare setting.

Special Guidance for Childcare Centers

Identification of Close Contacts

Identify close contacts by using the information in Section 4D. Unlike the classroom setting with school-aged children, all children in the classroom in a childcare setting are considered close contacts due to the nature of interaction between children (e.g., less than optimal cough etiquette, hand hygiene, and sharing/mouthing of toys in this age group).

Identification of High-Risk Individuals

Because of the age, immunization status, and other risk factors of many childcare attendees, make a special effort to identify exposed individuals and groups who are at higher risk of developing complications from pertussis or those who could transmit the disease to high-risk contacts.

These individuals should be referred to their providers, regardless of whether or not they have symptoms.

Identification of Symptomatic Close Contacts

Follow the recommendations in Section 4D. Ask about possible cases among attendees or employees within the previous four weeks. In settings involving infants, all potential cases should be investigated, and necessary measures

should be taken to stop further spread. Treatment should be initiated within 42 days (6 weeks) of cough onset in symptomatic infants <12 months of age and pregnant women in their 3rd trimester. However, there is no need to exclude individuals in these 2 groups if it has been at least 21 days since cough onset (regardless of antibiotic compliance). Additionally, treatment should be initiated in any coughing individual who is culture positive, regardless of time since cough onset.

Management of Close Contacts

Depending on the presence or absence of symptoms in the contact, the duration of cough, and the time since last exposure, manage the contacts as described in Section 4D. The exceptions from these recommendations are as follows:

1. Asymptomatic close contacts who attend/work in a setting where there are infants in the same room:
    a. If last exposure occurred ≤21 days ago:
        i. Diagnostic evaluation: No medical evaluation is needed.
        ii. Treatment/prophylaxis: Antibiotic prophylaxis is required.
        iii. Exclusion: No exclusion is required, unless appropriate antibiotics are not taken; then exclusion is for 21 days from last exposure to the infectious case.
    b. If last exposure occurred >21 days ago:
        i. Diagnostic evaluation: No medical evaluation is needed.
        ii. Prophylaxis: No antibiotic prophylaxis is required. However, prophylaxis should be considered for infants <12 months of age (particularly those <6 months of age, with <3 doses of DTaP) and pregnant women in their 3rd trimester. Please consult with MDPH about prophylaxis recommendations for individuals meeting these criteria.
        iii. Exclusion: No exclusion is required, even for infants <12 months of age and pregnant women in their 3rd trimester, even if they haven't received antibiotics in the 22–42 days after exposure.
2. Additionally, all asymptomatic contacts should be educated about the signs and symptoms of pertussis and should be advised to seek medical evaluation and testing, should symptoms develop. (*Note: For management of asymptomatic close contacts who do **not** have contact with infants, please refer to pages 605-606.*)

Review Immunization Status

See Section 4D for guidance.

Notification

Send letters of notification to parents and staff. If there are multiple cases over a short period of time, a general notification letter may be used to a wider group within the facility or institution. The MDPH can provide model letters, and these may be issued on the stationary of the affected institution or the LBOH. A Pertussis Fact Sheet and letters for health care providers are also available. Call the MDPH Division of Epidemiology and Immunization at (617) 983-6800 or (888)658-2850 for copies of these letters.

If feasible, it is helpful to telephone the contacts, especially the symptomatic ones, as well as sending the letters home. The affected institution usually makes these calls.

Conduct Active Surveillance

Continue initial surveillance efforts for 2 incubation periods (42 days) after the date of cough onset in the last case, as outlined in Section 4D.

Health Care Settings

Due to the potential for transmission to individuals at high risk of complications from pertussis, exposure criteria and control measures in health care settings are more rigorous than in other settings.

If there is a high index of suspicion of pertussis in a health care worker (regardless of there being an epidemiological link to a confirmed case or not), the individual should receive medical evaluation, appropriate diagnostic testing, and antibiotic treatment. The individual should also be excluded from the workplace through the first five days of the full course of antibiotics.

Please follow the steps for management of a case and contacts outlined in Section 4D, in conjunction with the health care-setting-specific guidance below. Please contact an immunization epidemiologist at the MDPH (available at [617] 983-6800 or [888] 658-2850) or your MDPH Regional Immunization Office to assist with case investigation and the development of institutional control measures.

Special Guidance for Health Care Settings

Control Measures for Case

1. Case is a patient:

   For patients (both inpatient and outpatient) that are cases, see Section 4C for recommendations on assessment, treatment/prophylaxis, and exclusion. Additional guidance includes the following:

   a. In the inpatient setting:

      i. If it has been ≤21 days from the patient's cough onset, isolate the confirmed or suspect inpatient case. The patient should be placed on droplet precautions until 5 days of the full course of antibiotic therapy have been completed.

      ii. If it has been >21 days since the patient's cough onset, isolation is not required.

   b. In the outpatient setting:

      i. Restrict the case from public activities for the first five days of the full course of antibiotic therapy.

      ii. In general, individuals who were in waiting rooms or other care areas at the same time as a pertussis case should not be considered close contacts.

2. Case is a health care worker:

   For health care workers that are confirmed cases, see Section 4C for recommendations on assessment, treatment/prophylaxis, and exclusion. The only caveat is that in some high-risk settings (e.g., where there is on-going contact with infants and/or pregnant women in their 3rd trimester), treatment and/or exclusion may be required within 42 days after cough onset. Please consult with the MDPH or the hospital epidemiologist regarding these situations.

Control Measures for Close Contacts

1. Identification of close contacts

   In health care settings, the definition of "close contact" is more rigorous and includes the following:

   a. Having face-to-face contact within three feet of the case, without wearing a surgical mask* or other protection of the face and respiratory tract; this includes conducting a medical examination, obtaining a NP culture, suctioning, intubating, performing bronchoscopy, or a similar procedure without wearing a mask.

   b. Conducting any procedure that induces coughing of the case, even if farther from the case than three feet, without wearing a surgical mask or other protection of the face and respiratory tract.

   c. Coming into mucosal contact with respiratory, oral, or nasal secretions of the case directly or via fomites.

   d. Sharing a room with the case; degree of contact and risk of infection in such situations should be evaluated on a case-by-case basis.

   e. Having any other close contact with a case, as defined in Section 4D.

   ** Please note that if a surgical mask was worn by the case and/or the contact during the entire exam, including specimen collection, there is no need for prophylaxis of the contact. However, this guidance is only for assessing exposures that have already taken place and does not allow a health care provider who is infectious with pertussis to continue working, even if wearing a mask.*

2. Identification of symptomatic close contacts

   See Section 4D, and please note the following:

   a. Ask about possible cases among employees within the previous four weeks.

   b. All potential cases should be investigated, and necessary measures should be taken to stop further spread.

3. Management of close contacts

   a. Contact is a patient:

      For patients (both inpatient and outpatient) that are identified as close contacts in the health care setting, see Section 4D for recommendations on assessment, treatment/prophylaxis, and exclusion. Additionally, please follow the isolation and quarantine requirements listed below:

      Symptomatic Case

      i. If coughing $\leq$21 days:

         - Diagnostic evaluation: Refer for medical evaluation and diagnostic testing, appropriate for cough duration. (See above for more information.)
         - Treatment/prophylaxis: Begin on presumptive antibiotic treatment (refer to *Attachment A: General Recommendations for Antibiotic Treatment and Prophylaxis of Pertussis,* at the end of this chapter, for further details).
         - Exclusion/isolation:
            - Inpatient: Isolate patient and place on droplet precautions until five days of the full antibiotic therapy have been completed.
            - Outpatient: Restrict from public activities for first five days of the full course of antibiotic therapy.

ii. If coughing >21 days:

- Diagnostic evaluation: Refer for medical evaluation and diagnostic testing, appropriate for cough duration. (See above for more information.)
- Treatment/prophylaxis: Antibiotic prophylaxis is not needed, as initiating treatment >21 days after onset of cough is unlikely to be beneficial. However, there are situations in which treatment is recommended >21 days after cough onset:
  - Treatment should be initiated within 42 days (6 weeks) of cough onset in infants <12 months of age and pregnant women in their 3rd trimester. Please consult with MDPH about treatment recommendations for individuals meeting these criteria.
  - Treatment should be initiated in any coughing individual who is culture positive, regardless of time since cough onset.

  Please refer to the section on timing of antibiotic treatment in *Attachment A: General Recommendations for Antibiotic Treatment and Prophylaxis of Pertussis,* at the end of this chapter, for further details.
- Exclusion/isolation:
  - Inpatient: Isolation is not required.
  - Outpatient: No exclusion is required.

Note: In certain situations deemed to be high-risk, the MDPH may make additional recommendations regarding control measures (e.g., treatment, prophylaxis, and exclusion).

Asymptomatic Case

All asymptomatic contacts should be educated about the signs and symptoms of pertussis and should be advised to seek medical evaluation and testing, should symptoms develop.

i. If last exposure occurred ≤21 days ago:

- Diagnostic evaluation: Refer for medical evaluation and diagnostic testing only if contact develops symptoms suggestive of pertussis. (See above for more information.)
- Prophylaxis: Antibiotic prophylaxis is recommended. Refer to *Attachment A: General Recommendations for Antibiotic Treatment and Prophylaxis of Pertussis,* at the end of this manual, for further information regarding antibiotics.
- Exclusion/isolation:
  - Inpatient: No isolation is required, unless appropriate antibiotics are not taken; then isolation is for 21 days from last exposure to the infectious case.
  - Outpatient: No exclusion is required, even if antibiotics are not taken, except for some transmission-risk contacts, which include health care workers and individuals in a childcare setting where there is contact with infants.

ii. If last exposure occurred >21 days ago:

- Diagnostic evaluation: None needed.
- Prophylaxis: Antibiotic prophylaxis is not needed, as initiating prophylaxis >21 days after onset of cough is unlikely to be beneficial. However, prophylaxis should be considered for infants <12

months of age (particularly those <6 months of age, with <3 doses of DTaP) and pregnant women in their 3rd trimester. Please consult with MDPH about prophylaxis recommendations for individuals meeting these criteria.

- Exclusion/isolation:
  - Inpatient: No isolation is required.
  - Outpatient: No exclusion is required.

Note: In certain situations deemed to be high-risk, the MDPH may make additional recommendations regarding control measures (e.g., treatment, prophylaxis, and exclusion.)

b. Contact is a health care worker:

Management of health care workers who are close contacts of a confirmed case is more stringent than for the general public. Based on the presence or absence of symptoms in the contact, the duration of cough, and the time since last exposure, manage these contacts as follows:

Symptomatic Health Care Workers

i. If coughing ≤21 days:

- Diagnostic evaluation: Refer for medical evaluation and diagnostic testing, appropriate for cough duration. (See above for more information.)
- Treatment/Prophylaxis: Begin on presumptive antibiotic treatment (refer to *Attachment A: General Recommendations for Antibiotic Treatment and Prophylaxis of Pertussis,* at the end of this chapter, for further details).
- Exclusion: Exclusion is the same as for a case. Exclude from public activities, school, and the workplace through the first 5 days of the full course of antibiotics or 21 days from the onset of cough for those who do not receive antibiotic treatment.

ii. If coughing >21 days:

- Diagnostic evaluation: Refer for medical evaluation and diagnostic testing, appropriate for age and cough duration. (See above for more information.)
- Treatment/prophylaxis: Antibiotic treatment for individuals is not recommended, as initiating treatment >21 days after onset of cough is unlikely to be beneficial. However, there are situations in which treatment is recommended >21 days after cough onset:
  - Treatment should be initiated within 42 days (6 weeks) of cough onset in pregnant women in their 3rd trimester. Please consult with the MDPH about treatment recommendations for individuals meeting these criteria.
  - Treatment should be initiated in any coughing individual who is culture positive, regardless of time since cough onset.

  Please refer to the section on timing of antibiotic treatment in *Attachment A: General Recommendations for Antibiotic Treatment and Prophylaxis of Pertussis,* at the end of this chapter, for further details.
- Exclusion: No exclusion is required.

Note: In certain situations deemed to be high-risk, the MDPH may make additional recommendations regarding control measures (e.g., treatment, prophylaxis, and exclusion).

Asymptomatic Health Care Workers

Asymptomatic contacts should be educated about the signs and symptoms of pertussis and should be advised to seek medical evaluation and testing, should symptoms develop.

i. If last exposure occurred ≤21 days ago:

- Diagnostic evaluation: Refer for medical evaluation and diagnostic testing only if contact develops symptoms suggestive of pertussis. (See above for more information.)
- Treatment/prophylaxis: Antibiotic prophylaxis is required per the isolation and quarantine requirements. Refer to *Attachment A: General Recommendations for Antibiotic Treatment and Prophylaxis of Pertussis,* at the end of this chapter, for further information regarding antibiotics.
- Exclusion: No exclusion is required, unless appropriate antibiotics are not taken. Then, exclusion is for 21 days from last exposure to the infectious case.

ii. If last exposure occurred >21 days ago:

- Diagnostic evaluation: None needed.
- Prophylaxis: Antibiotic prophylaxis is not needed, as initiating prophylaxis >21 days after onset of cough is unlikely to be beneficial. However, prophylaxis should be considered for pregnant women in their 3rd trimester. Please consult with MDPH about prophylaxis recommendations for individuals meeting these criteria.
- Exclusion: No exclusion is required.

For asymptomatic contacts whose only relevant exposure was to an epidemiologically-linked case (not laboratory-confirmed), prophylaxis depends on the setting.

Review Immunization Status

See above.

Notification

In addition to notifying providers, inform department heads, infection control, employee health, and other relevant personnel/departments of confirmed and suspect cases.

Conduct Active Surveillance

Continue cough surveillance for **2 incubation periods (42 days)** after the date of cough onset in the last case. This is of utmost importance in situations with high-risk individuals. In certain situations deemed to be high-risk, MDPH may make additional recommendations regarding control measures (e.g., treatment, prophylaxis, and exclusion).

D. Preventive Measures

Routine childhood vaccination, the Tdap booster dose, and post-exposure antimicrobial prophylaxis are the best preventive measures against pertussis. Good personal hygiene (which consists of proper hand hygiene, disposal of used tissues, not sharing eating utensils, etc.) is also important. Please refer to the most current versions of the ACIP statement on pertussis (listed under *References*), the MDPH's Immunization Guidelines, and MDPH's *Massachusetts Immunization Program State-Supplied Vaccines and Patient Eligibility Criteria* for details about the DTaP and Tdap vaccines, the recommended schedule, who should and should not get the vaccine, and who is eligible to receive state-supplied vaccine. In 2005, two formulations of diphtheria, tetanus, and acellular pertussis (Tdap) were licensed

for use in adolescents and adults. At the time of this publication, preliminary recommendations for adolescents are available; vaccination recommendations do not extend to adults at this time. Please call the MDPH at (617) 983-6800 or (888) 658-2850 for the most current immunization recommendations in these two age groups.

These, as well as other relevant resources, are available through the MDPH Division of Epidemiology and Immunization at (617) 983-6800 or (888) 658-2850.

A Pertussis Public Health Fact Sheet for the general public can be obtained from the MDPH Division of Epidemiology and Immunization or on the MDPH website at www.mass.gov/dph. Click on the "Publications and Statistics" link, and select the "Public Health Fact Sheets" section under "Communicable Disease Control."

ADDITIONAL INFORMATION

The following are the Massachusetts and CDC surveillance case definitions for pertussis. They are provided for your information only, and should not affect the investigation or reporting of a case that fulfills the criteria in Section 2A of this chapter. (The CDC and the MDPH use the CDC case definitions to maintain uniform standards for national reporting.) For reporting to the MDPH, always use the criteria outlined in Section 2A.

Note: The most up-to-date CDC case definitions are available on the CDC website at www.cdc.gov/epo/dphsi/casedef/case_definitions.htm.

The most significant difference between the MDPH and the CDC case definitions is that the MDPH includes positive pertussis serology results at the SLI as constituting laboratory confirmation, whereas the CDC does not. In practice, however, the CDC accepts SLI serology as confirmatory. Note that in a non-outbreak setting, the MDPH recommends control measures in response to laboratory-confirmed cases only; epidemiologically-linked cases do not warrant additional control measures, unless in an outbreak or high-risk setting.

Case Definition for Pertussis (As Defined in Massachusetts)

1. Non-outbreak setting:
   a. Laboratory confirmation by culture in a patient with any cough illness.
   b. A cough illness lasting $\geq$2 weeks, with laboratory confirmation by serology in a person not vaccinated with a pertussis-containing vaccine in the previous 3 years.
   c. A cough illness lasting $\geq$2 weeks with 1 or more of the following: paroxysms of coughing, inspiratory "whoop," or post-tussive vomiting, without other apparent cause, in an individual who has a positive PCR test.
   d. A cough illness lasting $\geq$2 weeks with one or more of the following: paroxysms of coughing, inspiratory "whoop," or post-tussive vomiting, without other apparent cause, without appropriately-timed negative laboratory test(s), in an individual who is epidemiologically-linked to a laboratory-confirmed case.

2. Outbreak setting (in institutional settings, ≥5 clustered cases whose cough onset dates are separated by <42 days [2 incubation periods], at least 1 of which is laboratory-confirmed; in household settings, >1 case):

   a. A cough illness lasting ≥2 weeks (with or without additional symptoms) without other apparent cause, without appropriately-timed negative laboratory test(s), and in an individual who is epidemiologically-linked to a laboratory-confirmed case.

Case Definition for Pertussis (As Defined by CDC)

Clinical Case Definition

A cough illness lasting ≥2 weeks with one of the following: paroxysms of coughing, inspiratory "whoop," or post-tussive vomiting, without other apparent cause.

Laboratory Criteria for Diagnosis

Isolation of *B. pertussis* from clinical specimen; or positive polymerase chain reaction (PCR) for *B. pertussis*.

Case Classification

Probable	A case that meets the clinical case definition, is not laboratory-confirmed, and is not epidemiologically-linked to a laboratory-confirmed case.
Confirmed	◆ An acute cough illness of any duration associated with *B. pertussis* infection; or ◆ A case that meets the clinical case definition and is confirmed by PCR; or ◆ A case that meets the clinical case definition and is epidemiologically-linked directly to a case confirmed by either culture or PCR.

REFERENCES

American Academy of Pediatrics. [Pertussis.] In: Pickering, L.K., ed. *Red Book: 2003 Report of the Committee on Infectious Diseases, 26th Edition*. Elk Grove Village, IL, American Academy of Pediatrics; 2003: 472–486.

CDC. *Guidelines for the Control of Pertussis Outbreaks*. CDC, 2000: Chapters 2, 3, 4 and 9, Updated January 2005. <www.cdc.gov/nip/publications/pertussis/guide.htm>.

CDC. *Advisory Committee on Immunization Practices (ACIP) Votes to Recommend Routine Use of Combined Tetanus, Diphtheria and Pertussis (Tdap) Vaccines for Adolescents*. December 16, 2005. <www.cdc.gov/nip/recs/provisional_recs/default.htm>.

CDC. *Advisory Committee on Immunization Practices (ACIP) Votes to Recommend Use of Combined Tetanus, Diphtheria and Pertussis (Tdap) Vaccine for Adults.* December 16, 2005. <www.cdc.gov/nip/recs/provisional_recs/default.htm>.

CDC. *Manual for the Surveillance of Vaccine-Preventable Diseases*. CDC, 1999.

CDC. Hypertrophic Pyloric Stenosis in Infants Following Pertussis Prophylaxis with Erythromycin—Knoxville, Tennessee. *MMWR.* 1999; 48(49): 1117–1120.

CDC. Recommended Antimicrobial Agents for Treatment and Postexposure Prophylaxis of Pertussis. *MMWR.* 2005; 54 (RR-14).
<www.cdc.gov/mmwr/PDF/rr/rr5414.pdf>.

Heymann, D., ed. *Control of Communicable Diseases Manual, 18th Edition*. Washington, DC, American Public Health Association, 2004.

Friedman, D.S., Curtis, C.R., Schauer, S.L., Salvi, S., Klapholz, H., Treadwell, T., Wortzman, J., Bisgard, K.M., Lett, S.M. Surveillance for Transmission and Antibiotic Adverse Events among Neonates and Adults Exposed to a Healthcare Worker with Pertussis. *Infection Control and Hospital Epidemiology.* 2004; 25: 967–973.

Hewlett, E.L., Edwards, K.M. Pertussis—Not Just for Kids. *The New England Journal of Medicine.* 2005; 352: 1215–1222.

Honein, M.A., Paulozzi, L.J., Himelright, I.M., et al. Infantile Hypertrophic Pyloric Stenosis after Pertussis Prophylaxis with Erythromycin: A Case Review and Cohort Study. *Lancet.* 1999; 354: 2101–2105.

Lee, G.M., Lett, S.M., Schauer, S., LeBaron, C., Murphy, T.V., Rusinak, D., Lieu, T.A. Societal Costs and Morbidity of Pertussis in Adolescents and Adults. *Clinical Infectious Diseases.* 2004; 39: 1572–1580.

Marchant, C.D., Loughlin, A.M., Lett, S.M. et al. Pertussis in Massachusetts, 1981–1991: Incidence, Serologic Diagnosis, and Vaccine Effectiveness. *Journal of Infectious Diseases.* 1994; 169: 1297–1305.

MDPH. *Regulation 105 CMR 300.000: Reportable Diseases, Surveillance, and Isolation and Quarantine Requirements*. MDPH, Promulgated November 4, 2005.

Wirsing von Konig, C-H. Use of Antibiotics in the Prevention and Treatment of Pertussis. *The Pediatric Infectious Disease Journal.* 2005; 24: S66–S68.

Yih, W.K., Lett, S.M., des Vignes, F.N., Garrison, K.M., Sipe, P.L., Marchant, C.D. The Increasing Incidence of Pertussis in Massachusetts Adolescents and Adults, 1989–1998. *Journal of Infectious Diseases.* 2000; 182: 1409–1416.

ATTACHMENTS

Attachment A: General Recommendations for Antibiotic Treatment and Prophylaxis of Pertussis

Attachment A

General Recommendations for Antibiotic Treatment and Prophylaxis of Pertussis

Summary of Changes to Recommendations for Antibiotic Treatment and Prophylaxis of Pertussis

A. New Antibiotics Approved

Clarithromycin and azithromycin are now approved for use in the treatment and prophylaxis of pertussis.

- For infants <1 month of age, azithromycin is preferred over erythromycin; clarithromycin is not recommended.
- In persons ≥1 month of age, erythromycin, clarithromycin, and azithromycin are the preferred antibiotics.
  - The 5-day dosing schedule in the Z-PAK® formulation of azithromycin is now acceptable for older children and adults.

Trimethoprim-sulfamethoxazole (TMP-SMZ) is no longer recommended, but may be used as an alternative agent in patients who are allergic to or cannot tolerate macrolides, or who are infected with a rare macrolide-resistant strain of *B. pertussis*.

B. Treatment

Recommended treatment courses:

- 5-day course of azithromycin.
- 7-day course of clarithromycin.
- 14-day course of erythromycin.

Treat within 3 weeks (21 days) of cough onset. However, there are situations in which treatment is recommended or considered >21 days after cough onset:

- Treatment should be initiated within 42 days (6 weeks) of cough onset in infants <12 months of age and pregnant women in their 3rd trimester. Please consult with MDPH about treatment recommendations for individuals meeting these criteria.
- Treatment should be initiated in any coughing individual who is culture positive, regardless of time since cough onset.
- For individuals who are serologically positive >21 days from cough onset, treatment is not usually indicated. In individuals who are PCR positive >21 days from cough onset, treatment could be considered (depending on the circumstances). Please consult with MDPH about treatment recommendations for individuals meeting the above criteria.

C. Antibiotic Prophylaxis

The antibiotic doses and schedules for prophylaxis are the same as for treatment. Initiate antibiotic prophylaxis within 21 days of exposure. However, prophylaxis should be considered within 42 days (6 weeks) after exposure for infants <12 months of age (particularly those <6 months of age, with <3 doses of DTaP) and pregnant women in their 3rd trimester. Please consult with MDPH about prophylaxis recommendations for individuals meeting these criteria.

D. Antibiotic Prophylaxis is Narrower and More Focused

Rationale

- Pertussis is now common in all communities in many age groups, and may not be diagnosed or reported.
- An individual may have multiple exposures but may only be able to identify some of these exposures.
- Prophylaxis must be given early in order to be effective.
- When pertussis is widespread in institutions and/or communities, antibiotic prophylaxis does not control transmission.
- In addition, due to multiple known exposures to cases of pertussis over a period of time (e.g., a few months), an individual could receive several courses of antibiotics, which could result in side effects and may promote the emergence of antibiotic resistance.

New Recommendations for Antibiotic Prophylaxis

- Because of the reasons described above, recommendations have been revised and **are now more targeted** in nature.
- Only close contacts (as defined in Section 4D) should receive antibiotic prophylaxis, and efforts should be focused on:
  - Contacts who are high-risk for severe pertussis disease (e.g., infants <1 year of age [particularly those <6 months of age], immunocompromised individuals, those with chronic lung disease, cystic fibrosis, neuromuscular disorders); or
  - Contacts who could transmit pertussis to those at high risk (household contacts, health care workers, pregnant women in 3rd trimester, childcare workers with infants in the room).
- High-risk individuals should receive antibiotic treatment or prophylaxis promptly.
  - Infants and other high-risk individuals in whom pertussis is suspected should be treated presumptively, after clinical specimens for diagnostic testing are obtained.
  - Infants and other high-risk individuals who are exposed to pertussis should **receive antibiotic prophylaxis promptly**.
- Broad-based antibiotic prophylaxis is no longer routinely recommended. In general, during a school or community outbreak, antibiotics are now only indicated for a **limited** number of individuals who are close contacts. Antibiotic prophylaxis is **no longer routinely recommended for entire classrooms** of school-aged children when there is only one laboratory-confirmed case of pertussis.

The antibiotics (including dosages and schedules) recommended for treatment and prophylaxis are identical. *The earlier antibiotics are started, the more effective they are in preventing disease transmission from the case to the contact, as well as from the contact to others.* The symptoms of pertussis may be modified if treatment is begun early during the catarrhal stage.

If treatment begins later in the course of illness, it will decrease the infectious period but may not decrease the duration of cough or severity of disease. Initiating antibiotic treatment in patients who have been coughing for >21 days has limited benefit, except in high-risk cases. Cases or symptomatic contacts that are infants <12 months of age and pregnant women in their 3rd trimester should receive antibiotic treatment within 42 days (6 weeks) of cough onset.

Those with close contact with a confirmed case must take the antibiotics for the prescribed number of days; if they do not, they must repeat the entire antibiotic course from the beginning.

Recent recommendations for antibiotic treatment and prophylaxis for pertussis, including detailed information on specific drugs, effectiveness, and side effects, can be found in *Recommended Antimicrobial Agents for Treatment and Post-exposure Prophylaxis of Pertussis* (CDC. *MMWR*. 2005; 54[RR-14]), which can be found on the CDC website at www.cdc.gov/mmwr/PDF/rr/rr5414.pdf.

The table below summarizes the CDC's latest recommendations for antibiotic treatment and prophylaxis of pertussis.

Summary of Oral Macrolide Treatment and Prophylaxis for Pertussis by Age Group[1]

DRUG	AGE GROUP			
	Adults	**Children and Infants ≥6 months**	**Infants 1–5 months**	**Infants <1 month**
Azithromycin (5-day course)	500 mg given as single dose on Day 1, then 250 mg per day on Days 2–5.	10 mg/kg/day in single dose on Day 1, then 5 mg/kg/day on Days 2–5.	10 mg/kg/day in single daily dose, for 5 days.[2]	Recommended agent. 10mg/kg/day in single daily dose for 5 days. (Only limited safety data are available.)[2]
Clarithromycin (7-day course)	500 mg 2 times per day for 7 days.	15 mg/kg/day in 2 divided doses (maximum 500 mg/dose) for 7 days.	Same dosage as noted for ≥6 months of age.[3]	Not recommended.[3] (Safety data unavailable.)
Erythromycin (14-day course)	500 mg 4 times per day for 14 days.	40–50 mg/kg/day in 4 divided doses (maximum 2 gm/day) for 14 days.	Same dosage as noted for ≥6 months of age (estolate preparation preferred, if available).	Use as alternate drug in doses as noted for ≥6 months of age. Drug use is associated with elevated risk of infantile hypertrophic pyloric stenosis (IHPS).

1 TMP-SMZ may be used as an alternative agent in patients ≥2 months of age who are allergic to or cannot tolerate macrolides or who are infected with a rare macrolide-resistant strain of *B. pertussis*. The recommended dose in children ≥2 months of age is trimethoprim 8 mg/kg/day, sulfamethoxazole 40 mg/kg/day in 2 divided doses for 14 days. For adults, the recommended dose is trimethoprim 320 mg/day, sulfamethoxazole 1600 mg/day in 2 divided doses for 14 days. Because of the risk of kernicterus, TMP-SMZ should not be given to pregnant women in the 3rd trimester, nursing mothers, premature neonates, or infants <2 months of age.

2 Azithromycin is not licensed for use in infants <6 months of age. Although safety data are limited, the data suggest that azithromycin results in fewer adverse effects in this age group and with no increased risk of IHPS. As a result, the CDC recommends azithromycin for infants <6 months of age, and it is the preferred drug for infants <1 month of age. Azithromycin is classified as a Food and Drug Administration (FDA) pregnancy Category B drug. (Animal reproductive studies have failed to demonstrate a risk to the fetus, and there have not been any adequate and well-controlled studies on pregnant women.)

3 Clarithromycin is not licensed for use in infants <6 months of age. Although safety data are limited, the data suggest that clarithromycin results in fewer adverse effects in this age group and with no increased risk of IHPS. As a result, the CDC recommends clarithromycin for use in infants <6 months of age, but not in infants <1 month of age. Clarithromycin is classified as a FDA pregnancy Category C drug.

Adapted from: Recommended Antimicrobial Agents for Treatment and Postexposure Prophylaxis of Pertussis. CDC. *MMWR*. 2005; 54(RR-14). This document can be found on the CDC website at www.cdc.gov/mmwr/PDF/rr/rr5414.pdf.

Note: Physicians who prescribe any macrolide antibiotics to infants <1 month of age should: 1) inform parents about the potential risks of developing IHPS and signs of IHPS, such as projectile vomiting or excessive irritability; and 2) report cases of pyloric stenosis following use of macrolides to MedWatch via telephone at (800) FDA-1088, via fax at (800) FDA-0178, or through the FDA website at www.fda.gov/medwatch. Cases should also be reported to the MDPH Division of Epidemiology and Immunization at (617) 983-6800 or (888) 658-2850.

E. Treatment of Cases

The macrolides erythromycin, clarithromycin, and azithromycin are preferred for the treatment of pertussis in persons ≥1 month of age. For infants <1 month of age, azithromycin is preferred over erythromycin, and clarithromycin is not recommended. An alternative to the macrolides for persons ≥2 months of age is trimethoprim-sulfamethoxazole.

High-Risk Individuals

Infants <1 year of age and other individuals at high risk for severe disease and complications (e.g., immunocompromised individuals, those with chronic lung disease, cystic fibrosis, or neuromuscular disorders) in whom pertussis is suspected should be **treated presumptively,** after clinical specimens for diagnostic testing are obtained.

Individuals with Pertussis Who Can Transmit the Disease

Those at high risk (household contacts, health care workers, pregnant women in 3rd trimester, childcare workers with infants in room) should also be treated presumptively and promptly.

Timing of Treatment

Treatment should be initiated as soon as possible after diagnosis in order to modify symptoms and to decrease the duration of the infectious period. Initiating treatment >21 days after cough onset is usually not recommended because it is unlikely to alter the clinical course of illness and the individual is beyond his/her infectious period. However, there are situations when treatment is recommended or considered >21 days after cough onset:

Treatment should be initiated within 42 days (6 weeks) of cough onset in infants <12 months of age and pregnant women in their 3rd trimester. Please consult with MDPH about treatment recommendations for individuals meeting these criteria.

Treatment should be initiated in any coughing individual who is culture positive, regardless of time since cough onset.

For individuals who are serologically positive >21 days from cough onset, treatment is not usually indicated. In individuals who are PCR positive >21 days from cough onset, treatment could be considered (depending on the circumstances). Please consult with MDPH about treatment recommendations for individuals meeting the above criteria.

Alternative Drugs

Trimethoprim-sulfamethoxazole is an approved alternative to the macrolides for persons ≥2 months of age. Cases may return to work or school after completing five days of treatment with trimethoprim-sulfamethoxazole. Doxycycline is sometimes used if a patient is unable to tolerate the usual antibiotics or trimethoprim-sulfamethoxazole, and some studies have shown it to be effective. However, doxycycline should be avoided in pregnant women and in children <8 years old. For control purposes, it is reasonable to admit to school/work, children/adults treated or prophylaxed with doxycycline. For a health care worker, however, the medical director or hospital epidemiologist should be consulted to make this determination.

Providers should consider safety, effectiveness, evaluation of concurrent medications for potential interactions, tolerability, adherence to the prescribed regimen, and cost when choosing a macrolide or alternative agent for any patient.

Other antimicrobial agents, such as ampicillin, amoxicillin, tetracycline, choloramphenicol, fluoroquinolones (e.g., ciprofloxacin, levofloxacin, ofloxacin, moxifloxacin), and cephalosporins exhibit various levels of in vitro inhibitory activity against *B. pertussis*, but in vitro inhibitory activity does not predict clinical effectiveness. The clinical effectiveness of these agents for treatment of pertussis has **not** been demonstrated. Some (e.g., ampicillin and amoxicillin) have been found to be ineffective in clearing *B. pertussis* from the nasopharynx. The minimum inhibitory concentration of *B. pertussis* to the cephalosporins is unacceptably high. In addition, tetracyclines, chloramphenicol, and fluoroquinolones have potentially harmful side effects in children. Therefore, **none** of the above antimicrobial agents are recommended for treatment or post-exposure prophylaxis of pertussis.

F. Prophylaxis of Contacts

The decision to administer post-exposure chemoprophylaxis is made after considering the infectiousness of the patient and the intensity of the exposure, the potential consequences of severe pertussis in the contact, and possibilities for secondary exposure of persons at high risk through the contact. The antibiotics (including dosages and schedules) recommended for treatment and prophylaxis are identical. However, the recommendations for antibiotic prophylaxis have been revised and are now much narrower in scope and more targeted in nature.

Because severe and sometimes fatal pertussis-related complications can occur in infants aged <1 year, especially among infants <4 months, post-exposure prophylaxis should be administered in exposure settings that include infants aged <1 year or pregnant women in their 3rd trimester. Please consult an immunization epidemiologist at MDPH to help determine the scope of recommendations for antibiotic prophylaxis in these and in other potentially high-risk settings.

Prophylaxis Should Be Focused

In most situations, **only** close contacts (as defined in Section 4D) should receive antibiotic prophylaxis and efforts should be focused on:

- Contacts who are at high risk for severe pertussis disease (e.g., infants, immunocompromised individuals, those with chronic lung disease, cystic fibrosis, neuromuscular disorders); or
- Contacts who could transmit pertussis to those at high risk (household contacts, health care workers, pregnant women in 3rd trimester, childcare workers with infants in the room).

In general, prophylaxis is not indicated for non-household, non-high-risk contacts of a case during a school or community outbreak. If prophylaxis is necessary, it should be recommended regardless of age and vaccination status. If close contacts of a pertussis case are symptomatic, they should have an appropriately-timed diagnostic test for pertussis and be presumptively treated as if they had pertussis. See *Treatment of Pertussis* section for information on alternate drugs.

Timing of Prophylaxis

Initiating prophylaxis >21 days after exposure to an infectious case is unlikely to be of benefit to the contact. However, prophylaxis should be considered for infants <12 months of age (particularly those <6 months of age, with <3 doses of DTaP) and pregnant women in their 3rd trimester. Please consult with MDPH about prophylaxis recommendations for individuals meeting these criteria.

Prophylaxis of Contacts of an Epidemiologically-linked Case

Prophylaxis of contacts (even household contacts) of an epidemiologically-linked case is not routinely recommended. Such contacts may wish to consult their providers. However, in certain high-risk settings (e.g., some medical settings, residential schools for ill, or disabled children, or other high-risk outbreak settings), MDPH may recommend prophylaxis of contacts of an epidemiologically-linked case.

G. Advantages of the Newer Macrolides (Azithromycin and Clarithromycin) over Erythromycin

Azithromycin and clarithromycin are as effective as erythromycin for the treatment of pertussis in previously immunized individuals >6 months of age and are better tolerated. Both achieve higher tissue concentrations and have longer half-lives than erythromycin, allowing less frequent administration (1–2 doses per day) and shorter treatment regimens (5–7 days). For the treatment of pertussis in infants <1 month of age, data are not available on the effectiveness of either azithromycin or clarithromycin. Both agents are contraindicated in patients with known hypersensitivity to any macrolide.

H. Special Considerations for the Treatment and Prophylaxis of Infants <6 Months of Age

Many infants this age are not fully immunized. If not treated, infants with pertussis remain culture-positive for longer periods than older children and adults who have been immunized against pertussis. However, limited data from small clinical trials do confirm the microbiologic effectiveness of azithromycin and clarithromycin against pertussis in infants <6 months of age, though data on the safety and efficacy of azithromycin and clarithromycin in this age group are scant. The FDA has not licensed these drugs for use in infants <6 months of age.

Infants 1–5 Months of Age

The CDC recommends azithromycin and clarithromycin for use in infants 1–5 months of age. Experts have concurred that the in vitro effectiveness of azithromycin and clarithromycin against *B. pertussis*, their demonstrated safety and effectiveness in older children and adults, and their more convenient dosing schedule justify their use as first line agents in infants 1–5 months of age.

Infants <1 Month of Age

The CDC recommends azithromycin as the preferred drug for infants <1 month of age. Clarithromycin is not recommended for use in infants in this age group. No data are available on the effectiveness of azithromycin and clarithromycin in this age group. There are only limited data from presented or published case series on the use of azithromycin in infants <1 month of age. These studies report a decrease in adverse events compared with

erythromycin, with no increased risk of IHPS in infants <1 month of age. However, for infants <1 month of age, the risk of developing severe pertussis and life-threatening complications outweighs any potential risk of IHPS that is associated with macrolide use.

Physicians who prescribe any macrolide antibiotics to infants <1 month of age should:

- Inform parents about the potential risks of developing IHPS and signs of IHPS, such as projectile vomiting or excessive irritability; and
- Report cases of pyloric stenosis following use of macrolides to MedWatch via telephone at (800) FDA-1088, via fax at (800) FDA-0178, or through the FDA website at www.fda.gov/medwatch. Cases should also be reported to the MDPH Division of Epidemiology and Immunization at (617) 983-6800 or (888) 658-2850.

FORMS & WORKSHEETS

Pertussis
(Also known as Whooping Cough)

Pertussis

(Also known as Whooping Cough)

LBOH Action Steps

This form does not need to be submitted to the MDPH with the case report form. It is for LBOH use and is meant as a quick-reference guide to pertussis case investigation activities.

LBOH staff should follow these steps when pertussis is suspected or confirmed in the community. For more detailed information, including disease epidemiology, reporting, case investigation, and follow-up, refer to the preceding chapter.

Note: Pertussis follow-up is sometimes undertaken by the LBOH and sometimes by the MDPH, depending on the capacity of the LBOH.

Reporting

- ❑ Notify the MDPH Division of Epidemiology and Immunization at (617) 983-6800 or (888) 658-2850 to report any confirmed case(s) of pertussis that were not tested at the SLI (MDPH will already know about cases tested at the SLI).

Case Investigation

- ❑ Work with MDPH to ensure that appropriate clinical specimens are collected and submitted to the SLI for confirmation.
- ❑ Work with MDPH to obtain the information necessary for completion of the case report form, including source of exposure, clinical information, vaccination history, laboratory results, and source of infection.
- ❑ Fill out a contact worksheet, and identify potential contacts of a case.
- ❑ Send the completed case report form (with laboratory results) to the MDPH Bureau of Communicable Disease Control, Office of Integrated Surveillance and Informatics Services (ISIS).

Prevention and Control

- ❑ Institute isolation and quarantine requirements (*105 CMR 300.200*) and other control measures, as they apply to a particular case.
- ❑ Identify close contacts, paying particular attention to those who are high-risk or transmission-risk contacts.
- ❑ Recommend antibiotic prophylaxis, if appropriate.
- ❑ Conduct surveillance for two incubation periods.

Managing Pertussis in Schools and Other Institutions

In addition to the prevention and control measures described above:

- ❑ Notify and educate staff, students, and/or patients.
- ❑ Test and exclude symptomatic contacts, as indicated.

Managing Pertussis in Health Care Settings

In addition to the prevention and control measures described above:

- ❑ Notify infection control or employee health of confirmed or suspect case(s) in institution.
- ❑ Test and exclude symptomatic contacts, as indicated.
- ❑ Ensure all health care personnel are receiving antibiotic prophylaxis.
- ❑ Exclude personnel from the workplace if appropriate antibiotics are not taken.